Remarks

Claims 13-17 were pending in the Application. Claims 13-17 have been Rejected under 35 U.S.C. 102

This Amendment Amends Claims 13-17 to correct for inadvertent errors such as the misspelling of "carbonate," antecedent errors, and improper dependency and adds New Claims 18-25.

Response to Detailed Action

Rejections Withdrawn

Applicant gratefully acknowledges the withdrawal of the following two previous Rejections:

1. The 35 U.S.C. 102(e)/103 rejection of claims 1-6,9-12 anticipated or obvious over Kasamatsu et al. has been withdrawn due to applicant's amendment filed on 7/5/2006.
2. The 35 U.S.C. 102(b)/103(a) rejection of claims 7-8 anticipated or obvious over Kawakami et al. has been withdrawn due to applicant's amendment filed on 7/5/2006.

Claim Rejections--35 USC § 102

The Examiner has stated:

> Claims 13-17 are rejected under 35 U.S.C. 102(e) as being anticipated by Narang et at (20040091774).
>
> **Specifically**
>
> As to claims 13-17, Narang et at discloses an electrolyte solution for a metal-air battery (page 2 paragraph 0020), where oxygen is reduced at a cathode surface to produce [O^{-2} or O_2^{-2}] ions (page 3 paragraph 0025), the battery comprising a lithium metal containing anode (page 2 paragraph 0022), a cathode for reducing the oxygen comprising carbon (page 3 paragraph 0032), the electrolyte comprising a lithium salt L1PF6 (page 4 paragraph 0036), and a non-aqueous solvent comprising dimethoxyethane (page 4 paragraph 0041).
>
> As to the oxygen solubility of the solvent is at least 0.1150cc 02/cc at STP, since Narang et al. discloses the solvent desired by the applicant, it is inherent that the oxygen solubility of the solvent is at least 0.1150cc 02/cc at STP.

Response

With consideration of the attached Declaration of Jeffrey A. Read, Applicant requests the withdrawal of Narang, *et al.* as a prior art reference under 35 U.S.C. §102(e). Dr. Read offers as evidence of prior invention the Invention Disclosure submitted to his laboratory Legal Office and the supporting Laboratory Notebook pages. With the removal of Narang, *et al.* as a prior art reference, Applicant submits that this rejection has been overcome. With the Allowability of independent claims 13, 14 and 16, Claims 15 and 17 are likewise now believed to be in Allowable form.

Beyond the believed patentability of the pending claims over Narang, *et al.* on the basis of prior invention, Applicant submits that patentable distinctions exist between the pending claims and the teachings of Narang, *et al.* Anticipation has always been held to require absolute identity between the claimed invention and the teachings found within a single prior art reference.

In contrast to Applicant's Claimed Invention, Narang, *et al.* teaches the following:

Narang, *et al.'s* Patent Application states in its title that it is for "Metal/Active Oxygen Batteries" They state in their detailed description the term "active oxygen" to mean O_2^- (superoxide ion) and O_2^{-2} (peroxide ion), (page 3, paragraph 0025). Narang, *et al.* envisions that the "active oxygen" is bound to a cation such as Li^+ as in Li_2O_2, or to alkyl species such as in acetyl acetone peroxide. Their intent is to use the "active oxygen" in a solid or liquid form and store it in the cell. Narang, *et al.* does not mention O_2 as a possible cathode material for their battery since it cannot be stored in a solid or liquid form and does not meet their criteria for being "active oxygen". Narang *et al.* does mention lithium/air batteries in the Background of the Invention section where they say "The lithium/air and aluminum/air batteries have the highest theoretical specific energy and good efficiency, but air needs to be fed to the cathode in order for the battery to operate" (page 1, paragraph. 0008, line 4). This "feeding" of the cathode is exactly the point of Applicant's Invention. The faster you can "feed" the cathode the more energy you can get out of the battery due to the O_2 transport limitations.

The **metal-oxygen battery** is distinguished from the **Metal/Active Oxygen Battery** by several factors. The first factor is that the **metal-oxygen battery** uses a soluble cathode material, *i.e.* O_2, that needs to be transported through the bulk of a carbon black electrode that acts as a current collector for the cathode reaction (cathode reaction: $O_2 + 2e^- \rightarrow O_2^{-2}$). The **Active Oxygen Battery** as described by Narang *et al.*, as well as other lithium primary batteries, already has the cathode material in place with no transport being necessary. The **metal-oxygen battery** functions properly only when the O_2 can be transported into the cell through the electrolyte in a quick and efficient manner. It is the ability of the electrolyte to transport the O_2 that is of most importance and is what distinguishes a lithium-oxygen battery electrolyte from a lithium-ion battery electrolyte.

The second factor that distinguishes a metal-oxygen battery from a **Metal/Active Oxygen Battery** is that the discharge product ($2Li^+ + O_2^{-2} \rightarrow \mathbf{Li_2O_2}$) is deposited in the cathode as a solid and discharge ends when the carbon black electrode is full of Li_2O_2. Discharge in a **Metal/Active Oxygen Battery** ceases when all of the "active oxygen" is reduced/consumed.

A person skilled in the art of batteries would not know from the Narang *et al.* work or any other published work how to determine a useful and practical electrolyte for a **metal-oxygen battery.** There is no information on oxygen solubility or viscosity (related to O_2 diffusion and transport). It not only is not disclosed; it would not be obvious to a person of ordinary skill in battery electrolyte art .

Applicant respectfully disagrees with the Examiner's conclusion from page 2, paragraph 0020, that Narang, *et al.* discloses an electrolyte solution for a **metal-air battery**. Narang, *et al.* is speaking of a **Metal/Active Oxygen Battery**. An Inventor is free to be his own lexicographer; however, once an Inventor has explained what he means by his words in his Patent or Patent Application, neither a Patent Examiner nor any third party is free to change the meaning of the terms as used to refer to something different than the Inventor intended.

Applicant wrote its Application based on the fact that Abraham had disclosed in U.S. Patent 5,510,209 that certain solvents should be used for the lithium-oxygen battery. Those solvents, he taught, should have high dielectric constants and high boiling points. Abraham indicated nothing about solubility. In fact, Applicant claims solvents at the other end of the spectrum (low dielectric constant and low boiling point) because they lead to higher solubility for oxygen. There is very little reference material available for these types of measurements on battery electrolytes. Applicant himself has published most of what is available in the area on both the solvents and electrolytes.

As to which solvent will "work" for **metal-oxygen batteries,** the answer is most lithium-oxygen battery and Metal/Active Oxygen Battery solvents will "work" but to varying degrees. Some of the solvents are not stable with the metal anode (*e.g.* methyl acetate), some are not stable with the discharge product (DEC) and some have very low oxygen solubility (*e.g.* EC) that leads to almost no discharge capacity in the metal-oxygen battery. Applicant has published data as to which solvents work better (PC and EC are poor) and which solvents are better (DOL, DME).

In Applicants' Application, (Specification, paragraph [0003]), Applicant specifies what kind of battery Applicant intends this Invention for and on (paragraph [0006') we state that "In accord with the present invention, it has been found that the solubility of oxygen in a solvent is the primary factor which must be considered when formulating electrolytes for **metal-oxygen batteries**." As Applicant stated in its Response to the Office Action mailed 06/16/2005 in relation to the Kasamatsu, *et al.* Published Patent Application 2003096168, the cited reference just does not describe Applicant's Invention. Applicant's

Invention as Claimed is based on the fact that oxygen solubility has to be considered a deciding factor in choosing electrolyte solvents for a non-aqueous **metal**-oxygen battery; it has nothing to do with a **Metal/Active Oxygen Battery**, which while they have names that sound alike, operate in an entirely different manner as described above. In other words, again, this is one of those cases in which the Preamble to the Claim is relevant.

In fact, if the work of Narang, *et al.* had any relevance to Applicant's Invention, then much earlier works which themselves disclose Narang, *et al.*'s Claimed Invention, would have already Anticipated Applicant's Invention. See any of the following references – none of which are prior art against Applicant's Claim Invention because of the different type battery.

1. A study on the Li/Li_2O_2 battery was reported in June 1995 in the final report for USAF Contract #F29601-94-C-0150.
2. "Investigation of lithium peroxide as a positive electrode material in a lithium polymer electrolyte battery." Avail. UMI, Order No. DA9817700. (1998), 188 pp. From: Diss. Abstr. Int., B 1998, 58(12), 6704.
3. Wardinsky, Michael D.; Bennion, Douglas N. "Investigation of lithium peroxide as the positive electrode material in a solid-state thin-film lithium battery." Proceedings - Electrochemical Society (1993), 93-23(Proceedings of the Symposium on New Sealed Rechargeable Batteries and Supercapacitors, 1993), 389-400. CODEN: PESODO ISSN:0161-6374. CAN 120:34441 AN 1994:34441 CAPLUS

Applicant further notes that the Narang, *et al* reference cited, US 2004/0091774 A1, has Issued as U.S. Patent 6,991,876 B2.

Applicant again submits that Narang, *et al.* does not Anticipate Applicant's Claimed Invention.

In light of the above remarks, reconsideration and withdrawal of the rejection as to Claims 13-17 under 35 U.S.C. §102(e) as being anticipated by Narang, *et al.* is solicited.

New Claims

In regard to New Claims 18-25, these New Claims bring the total number of pending Claims in this Application to 13, and the total number of Independent Claims to 10 with Applicant previously having paid for the Examination of 20 Total Claims and 4 Independent Claims. Applicant has indicated a Fee for payment for 6 New Independent Claims in block 3.a.iii of the Request for Continued Examination Form. New Claims 18-25 emphasize the novelty of Applicant's Invention focusing on the recognition that oxygen solubility has to be considered a deciding factor in choosing electrolyte solvents for a non aqueous metal-oxygen battery. New Claims 18-25 are primarily drawn to a combination electrolyte solvent wherein a solvent with a single solvent oxygen solubility

of less than 0.1150 cc O_2/cc at STP is in combination with at least one of a group of electrolytes whose single solvent oxygen solubility is in excess of 0.1150 cc O_2/cc at STP so that the solubility of the mixture is a solvent with an oxygen solubility of at least 0.1150 cc O_2/cc at STP. As Applicant noted at paragraph [0018] of the Specification with reference to Figure 1, the "mixtures of the present invention provide significantly greater capacity than do the prior art compositions," and with reference to Figure 2, "Again, it will be seen that the materials of the present invention provided significantly better performance at all current levels than did cells using prior art electrolytes." As Applicant further noted in paragraph [0019] of the specification with reference to Figure 3, "an increase in the amount of dissolved oxygen increases the specific capacity of the carbon cathode." Neither Narang, *et al.* nor any other reference cited by the Examiner teaches that the oxygen solubility of a solvent is the key to determining better performance of an electrolyte made from such a solvent and a lithium salt in a metal-oxygen battery. No new matter has been added as each of the materials with a relatively low solubility are listed in paragraph [0015] of the Specification along with directions for

Conclusion

Applicant believes that the Amendments made above respond to each and every one of the Examiner's Rejections and are such as to place the Application into Condition for Allowance. Applicant respectfully requests that a timely Notice of Allowance be issued in this case.

The Examiner is invited to telephone the undersigned at the local telephone number given below if, after considering this amendment, the Examiner is of the opinion that the Amendments made by Applicant have not resolved all outstanding issues in this case and brought the case into Condition for Allowance.

Respectfully submitted,

28 FEBRUARY 2007
DATE

William V. Adams
Attorney for Applicants
Reg. No. 32,552
(703) 806-8255